RUNNING HEAD: Brown ADD Scales, ADHD, and RD

Validity of the Brown ADD Scales: An Investigation in a Predominantly Inattentive ADHD Adolescent Sample with and without Reading Disabilities

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Abstract

The Brown ADD Scale for Adolescents is used widely clinically yet no published studies have investigated divergent and concurrent validity, specificity and sensitivity to inattentive ADHD symptomatology. Ninety-eight participants (13 to 16 years) were classified as ADHD/I and/or reading disabled (RD) using K-SADS, Conners Rating Scales (CRS-R) and Ontario Child Health Study Scales (OCHSS), WRAT3 and WRMT-R, resulting in 29 ADHD/I; 12 RD, 16 ADHD/I with RD; and 41 controls. The RD group was included to evaluate specificity. The Brown was administered but not used in classification. The ADHD groups scored higher on the Brown subscales compared with the other two groups. The recommended cutoffs resulted in high rates of false negatives but few false positives; suggesting good specificity but poor sensitivity. There were moderate correlations among the Brown, CRS-R and OCHSS. The Brown can be useful in screening out ADHD; however, its low sensitivity precludes its usefulness in diagnosing ADHD.

Key Words: ADHD, RD, adolescents, Brown ADD Scales, inattentive type

Validity of the Brown ADD Scales: An Investigation in a Predominantly Inattentive ADHD Adolescent Sample with and without Reading Disabilities

The Brown ADD Scale for adolescents is a widely used self-report instrument for the assessment of ADHD introduced into mainstream clinical practice over the last half decade. However, despite its popularity, no published studies outside of those of the developer (Brown, 1996) have investigated its psychometric properties. This scale is different from all other self-report rating scales (e.g., the Youth Self-Report Form (Achenbach, 1991), the Adolescent Behavior Checklist (Adams, Kelley, & McCarthy, 1997), the Revised Ontario Child Health Studies Scale (OCHSS, Boyle, Offord, Racine, Fleming, Szatmari, & Sanford, 1993), and the Conners-Wells Adolescent Self-report Scale (Conners, 1997)) in that it reflects a move away from asking specifically about the hyperactive and impulsive symptoms outlined in the DSM-IV (APA, 2000) and attempts instead to assess for inattentive symptoms as well as assessing for the well documented cognitive problems inherent in the disorder, such as problems with time management, slow processing speed and poor working memory (Tannock, 1998).

Self-report of ADHD symptoms by children and adolescents has been identified as unreliable, with both children and adolescents having been found to underestimate problems of overactivity and inattention when compared with teacher and parent report (Danckaerts, Heptinstall, Chadwick, & Taylor, 1999; Fischer, Barkley, Fletcher, & Smallish, 1993; Smith, Pelham, Gnagy, Molina, & Evans, 2000). However, as the majority of this research uses individuals with both the hyperactive/impulsive symptoms and the inattentive symptoms, what is less known is whether those individuals with <u>mainly</u> the inattentive symptoms are equally unreliable reporters. Given that researchers recommend that self-report be less heavily weighted, confirmation is required that these results apply to individuals with all types of ADHD. Therefore, investigations into psychometric properties of newly marketed scales (such as the Brown ADD Scales), especially ones that diverge

from the mainstream scales currently in use, are crucial for providing clinicians with directions for their assessments. What is also currently unknown is whether observers are more sensitive to the frequency and the impairing nature of cognitive and attention deficits or whether only the individual affected by these symptoms can veritably describe and report on the internal experience of these problems with inattention. No studies have investigated the psychometric properties of any self-report instrument in a population of adolescents identified with ADHD, Predominantly Inattentive Type. It is the goal of this study to investigate these properties in the Brown ADD Scale for adolescents.

As with all instruments, it is important to assess an instrument's validity, that is, how well does it measure what it purports to measure. One significant obstacle with respect to assessing inattentive symptoms is determining whether such symptoms are due to an underlying attentional problem or can be better accounted for by another disorder. Both psychiatric and non-psychiatric problems could result in significant difficulties with inattention. For example, inattention can be a cardinal feature of both the depression and anxiety disorders. Current life stressors such as problems in school caused by a learning problem, family conflict and peer relationship problems could all result in poor ability to attend and concentrate. Of relevance to this study, individuals with reading disabilities (RD) can manifest some symptoms of ADHD, particularly the inattentive symptoms, such as inattention to detail in reading, apparent difficulty with completion of homework or avoidance of work, specifically related to reading. If, as the literature suggests, RD and ADHD are distinct disorders (Shaywitz et al., 1995), then it is important that assessment instruments are able to distinguish between them. Therefore, to establish specificity of any instrument designed to assess for the inattentive symptoms, it would be important that it showed good discriminatory abilities between ADHD, Predominantly Inattentive Type, and RD given the high overlap in clinical presentations.

As indicated, there have been no published reports on the validity of the Brown ADD Scale for adolescents outside of those published by the developer of the instrument (Brown, 1996). Given the significant use of this scale clinically, it is vital that more research be dedicated to investigating its properties. More specifically, there has been no study that has focused on a cohort of ADHD adolescents identified with the Predominantly Inattentive Type and compared their scores on the Brown ADD Scales with a cohort of adolescents with RD. This scale has also never been compared to other well-validated instruments. Therefore, the purpose of this study was multifold: 1) to evaluate the discriminant validity of the Brown ADD Scales by assessing group differences on the subscales among adolescents identified with ADHD, Predominantly Inattentive Type, and normal controls as well as with adolescents identified with a reading disability, 2) to evaluate criterion validity of the Brown ADD Scales by comparing it with the Conners Rating Scales and the OCHSS, and 3) to verify its discriminant function capabilities as compared with the two above named instruments. A comorbid group (ADHD+RD) was also included, a necessary comparison group to determine whether their responses are more similar to the ADHD group or the RD group.

Method

Subjects

A total of 98 subjects (aged 13 to 16 years) were included in this study: 41 controls; 12 RD; 29 ADHD, Predominantly Inattentive Type; and 16 ADHD, Predominantly Inattentive Type with RD. This sample represents a subset of a larger sample (123) of adolescents recruited for our gender study on ADHD (Rucklidge & Tannock, 2001), the main difference between the two samples being that the three ADHD subtypes (Inattentive, Hyperactive/Impulsive, and Combined) were included in the gender sample whereas only the Inattentive Type were included in this study, the rationale described below. Gender distributions across three of the four groups was fairly even (53.7% of the

control group, 48.3% of the ADHD/I, and 50% of the RD group were female) except in the combined group where only one quarter of the group was female.

About half of the two ADHD groups were recruited from patients who were previously assessed in the Department of Psychiatry with a confirmed diagnosis of ADHD in childhood based on a standard clinical diagnostic protocol and standardized parent and teacher behavior rating scales. The remaining clinical subjects were recruited through advertisements at pediatric offices as well as from new referrals to the Hospital for Sick Children. The RD group was not actively recruited: they were individuals who responded to our advertisements looking for volunteers for research and subsequently identified as having reading problems through the testing. Adolescents in the control group were recruited through Hospital staff and community resources.

Inclusion criteria for the ADHD group: a confirmed diagnosis of childhood ADHD as well as current diagnosis of ADHD (see below). Only those meeting criteria for ADHD, Predominantly Inattentive Type, were included in the analyses presented in this paper. As the purpose of specific part of the study was to document the discriminant validity of the Brown ADD Scales in differentiating between the Inattentive Type of ADHD and RD, we excluded those children with the Combined or Predominantly Hyperactive/Impulsive Type from the analyses (n = 11). Inclusion criteria for the RD group: standard score below the 25th percentile (SS 90) on one of the following subtests: word identification or word attack subtests of the Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock and Mather, 1989) or the spelling or reading subtests of the Wide-Range Achievement Test (WRAT3; Wilkinson, 1993). This system of classifying the RD group using low achievement scores was used as there is little or no evidence to support the validity of the IQ-discrepancy model (Fletcher et al., 1994; Vellutino, Scanlon, & Lyon, 2000). A cut off of 90 has been used previously in the research and may be a more appropriate cut-off with this age group (Bruck, 1992; Fletcher et al., 1998; Frankenberger & Fronzaglio, 1991), and further, this cutoff

identifies children who are impaired compared with their peers, performing at least two to three grades below expected grade level. Spelling scores were used as indicators of overall reading problems due to the extensive literature demonstrating that spelling is just as much an indicator of literacy and language based skills as reading (Burt & Fury, 2000; Kamhi & Hinton, 2000). Inclusion criteria for the ADHD+RD group: the individual met inclusion criteria for both the ADHD group and the RD group. Again, only those children who met criteria for ADHD, Predominantly Inattentive Type, were included in this clinical group. Specific exclusion criteria for the control group: history or current complaints of problems in attention, hyperactivity or impulsivity, resulting in the exclusion of another nine adolescents. Exclusion criteria for all groups: 1) an estimated IQ below 80, using the Block Design and Vocabulary subtests of the WISC-III (Wechsler, 1991), and 2) subjects with uncorrected problems in vision or hearing, serious medical problems, such as epilepsy or cerebral palsy, or serious psychopathology, such as psychosis, that would preclude a current differential diagnosis of ADHD. These final exclusion criteria resulted in the exclusion of another five participants. All participants were native English speakers.

Diagnostic Protocol for ADHD and other psychiatric disorders: Systematic information about current and lifetime disorders was obtained from both the child and the parent separately using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL), an interview which generates both DSM-IIIR and DSM-IV diagnoses. This semi-structured interview has been used extensively to make diagnostic decisions based on DSM criteria and has been validated with children aged 6 to 17 (Kaufman et al., 1997). Behaviour rating scales: The Revised Ontario Child Health Study Scales (OCHSS; Boyle et al., 1993) and the Conners' Rating Scales-Revised (CRS-R; Conners, 1997) were used to assess ADHD as well as internalizing and externalizing disorders including depression, anxiety and conduct disorder. These two instruments provide separate rating forms for parents, teachers and adolescents.

The OCHSS also provides separate scales for parent, teacher and adolescent to give an overall estimate of impairment.

To assess for presence or absence of ADHD, the following diagnostic algorithm was used: 1) the child met DSM-IV criteria for ADHD according to the clinician summary based on the K-SADS parent and adolescent interview, 2) met the clinical cutoffs for the externalizing symptoms of ADHD on the Conners teacher questionnaires in order to ensure pervasiveness of symptoms across settings, and 3) showed evidence of ADHD symptoms prior to the age of seven established either through a past diagnosis of ADHD or in new cases, according to parental report and school report cards. Impairment was confirmed using the OCHSS impairment scale. Note that the information from the adolescent K-SADS did not supersede parental report for the presence/absence of externalizing symptoms.

Measures of demographic variables

Measures of the socioeconomic status of the family was determined using the Blishen Index (Blishen et al., 1987), an index which assigns Canadian occupations with a socio-economic score (SES) from 1 (low SES) to 6 (high SES). Highest education level achieved by each parents (from 1 “no high school” to 6 “university degree”) was also used as a measure of economic status.

Dependent Measure

As part of the assessment, the Brown Adolescent ADD Scale was administered (Brown, 1996); however, the results were not used as part of the diagnostic protocol. As such, the scores could be used to assess the scale’s ability to discriminate among the various clinical groups. This scale produces an overall total score where the higher the score the greater the likelihood that the individual has ADHD. Based on the total score, an individual’s score falls into one of three categories: 1) ADD possible but not likely (Below 40), 2) ADD probable but not certain (between 40 and 54), and 3) ADD highly probable (55 and above). It also has five subscales: 1) Activation

assessing problems related to organizing and initiating work activities (e.g., “Is hard to wake up in the morning; finds it difficult to get out of bed and to get going”), 2) Attention which taps into problems associated with chronic difficulties sustaining attention (e.g., “Gets lost in daydreaming or is preoccupied with own thoughts”), 3) Effort which elicits self-report on inconsistent energy or insufficiently sustained effort (e.g., “Is criticized by self or others for being lazy”), 4) Affect which taps into problems related to poor social interactions and mood difficulties (e.g., “Is easily frustrated and excessively impatient”), and 5) Memory which specifically targets functions of memory such as working memory (e.g., “Intends to do things but forgets”). All these scales are believed to tap into the more subtle cognitive and executive deficits as well as the affect disturbances inherent in individuals affected with ADHD.

Brown (1996) has demonstrated that with adolescents, the Brown scale shows a satisfactory level of reliability (test-retest reliability over a two-week period: .87, adolescent/parent report correlation: .84), a high level of internal consistency with an overall chronbach coefficient alpha level of .95 for the adolescent scale, satisfactory discriminant validity as indicated by large effect sizes when comparing scores on the Brown across groups with and without ADHD, but only adequate sensitivity and specificity (10% false negatives and 22% false positives in an adolescent sample, rates that were adjusted for the base rate of 5% in the general population).

Procedures

The interviews were carried out in the research unit of a large paediatric health sciences research centre in metropolitan Toronto. The local institutional review board approved the study and written informed consent and assent (for children under the age of 16) were obtained from parent and adolescent respectively. Questionnaire packages were sent to the adolescent's teachers with the consent of the parents. A Ph.D. level clinical psychologist (JR) conducted all psychiatric interviews. All subjects were reimbursed for costs of parking and lunch. All adolescent controls were assessed

using the KSADS; their parents were only interviewed if concerns were raised based on their responses in the parent questionnaires.

Results

Results were analyzed using the Statistical Package for the Social Sciences-Windows version 10. Multivariate and univariate analyses of variance (MANOVA & ANOVA) were used to examine group differences. Wilks' lambda was used as the overall test of significance and if the overall omnibus F was significant ($p < .05$), the subsequent univariate analyses were interpreted. Post-hoc Bonferroni tests were performed to determine which groups were significantly different from each other.

There were no group differences in age, level of education of mothers and fathers, in overall estimates of socio-economic status, and marital status (F (18, 258) = .651, p = .857). Table 1 shows the sample characteristics, including age, WRAT3 and WRMT-R scores, and number of ADHD, ODD, and CD symptoms per group. As expected, the ADHD groups had significantly more symptoms of inattention, hyperactivity and impulsivity as compared with the RD group and normal controls. The ADHD groups also showed significantly more oppositional and conduct problems than the normal controls. By definition, the RD groups were more impaired in the reading, spelling, word identification and work attack subtests of the WRAT3 and the WRMT-R than the ADHD group and the normal controls. The RD and the ADHD groups had lower estimated IQs as compared with the normal controls.

Insert Table 1 here

Table 2 illustrates the means, standard deviations and F tests for the Brown ADD Subscales. The raw scores are presented as the T scores provided in the manual do not go below 50, hence

overinflating low scores and introducing the risk of eliminating veritable group differences. Both the ADHD and the ADHD+RD groups endorsed significantly more of the items than the normal control group. Further, the Activation, Attention, and Effort subscales were significantly more elevated in the two ADHD groups as compared with the RD group. Finally, there were significant group differences between the ADHD+RD group and the RD group on the other two subscales of Affect and Memory. The analyses were rerun using IQ as a covariate and there was no change in the pattern of results.

Insert Table 2

Table 3 shows the number of participants across the four groups who would have been classified as unlikely ADD, probable ADD but not certain, or ADD highly probable as determined by the suggested cutoffs for the scale, giving an indication of the number of false positives and false negatives. These figures allow us to investigate the scale's sensitivity and specificity: sensitivity refers to the scale's capacity to identify cases correctly or the probability that a person with ADHD will be identified by the instrument and thus avoiding false negatives. Specificity refers to the scale's capacity to discriminate those with ADHD from those without ADHD or the probability that an individual without ADHD will be so identified and thus avoiding false positives. The distribution of participants across these three categories suggests that, using the stricter cutoff of a raw score of 55, the Brown ADD Scale has excellent specificity in that only one participant in that higher cutoff group is a false positive; however, using this same cutoff, there is a high rate of false negatives (46.7%), indicating poor sensitivity. In other words, if a participant receives a high score on this scale, he/she is likely to have ADHD as determined by a multiple-informant interview. However, the high rate of false negatives suggests that many individuals deemed as having ADHD according

to a thorough clinical assessment do not endorse the symptoms on the Brown ADD Scale to a clinically significant degree. Overall, this level of specificity and sensitivity indicates questionable discriminant validity due to its unacceptably low sensitivity. Of course using the less stringent cutoff decreases the rate of false negatives but increases the rate of false positives. Table 3 also illustrates the percentages of participants falling in the three cutoff groups when collapsing across RD.

Insert Table 3 here

Table 4 illustrates the correlations among the subscales of the Brown ADD Scale and selected subscales of the Parent, Teacher and Adolescent Conners' Rating Scales, the total number of inattentive symptoms and hyperactive/impulsive symptoms as determined by the K-SADS-PL interview, and the OCHSS Parent, Teacher and Youth Scales. The high correlations indicate that the Brown ADD Scale shows satisfactory criterion (concurrent) validity. All correlations are at a significance level of $p < .001$ and range from .274 to .809.

Insert Table 4 here

As three self-report measures had been administered but none of the self-report subscales were used for classification purposes (CRS-R, OCHSS, and the Brown ADD Scales), a discriminant function analysis was used to determine what combination of the subscales of these three scales measured was best able to discriminate between those adolescents identified as ADHD and those who were not. All 98 subjects were included in the analyses and two groups were formed by collapsing across RD status: 45 ADHD and 53 nonADHD. All the subscales of the Conners-Wells

Adolescent Self-report Scale, the OCHSS Youth Report and the Brown ADD Scale were entered into the discriminant function and a forward stepwise function was used to determine those subscales best able to discriminate between the two groups (ADHD/nonADHD) which means those subscales that statistically account for more variability is entered first. At the first step, the Brown subscale of Attention entered (F (1, 96) = 95.389, $p < .001$). At the second step, the Brown ADD subscale of Effort was entered (F (1, 95) = 52.366, $p < .001$). Finally, at the third step the Family Problems subscale of the CRS-R was entered (F (1, 95) = 37.327, $p < .001$). No other subscale met inclusion criteria. Using these three subscales as discriminant function coefficients, the cannonical correlation was .737 with an eigenvalue of 1.191. Overall, 86.7% (n=85) of the original grouped cases were correctly classified: 94.3% (n=50) of the nonADHD group and 77.8% (n=35) of the ADHD group, indicating excellent specificity but moderate sensitivity of this combination of subscales.

Discussion

This study investigated the psychometric properties of the Brown ADD Scale for adolescents using a population of adolescents with and without ADHD and RD. The scale's discriminatory abilities were assessed by investigating the rate of false positive and false negative ADHD diagnoses within this sample according to the defined cutoffs in the Brown manual and as compared to the gold standard of diagnosis (assessment across multiple informants and across time). Using the more stringent cutoff of 55, the Brown correctly classified 77.6% of the participants as either ADHD/nonADHD; however, although only one nonADHD participant was classified with this cutoff as ADHD, 46.7% of those below that cutoff were false negatives. Using a less stringent cutoff naturally decreases the rate of false negatives, but it also increases the rate of false positives, that is classifying a nonADHD individual as having ADHD. Depending on how the scale is being used usually directs the recommended cutoff. Clinically, this means that the scale is

useful in determining those individuals who do not have ADHD (and this statement extends to the RD population), but is less reliable when it comes to identifying ADHD adolescents as having ADHD. In other words, if an individual receives a high score on this scale, the probability that individual has ADHD is high; however, a low score does not rule out ADHD, indicating good specificity but poor sensitivity. Therefore, there was a high percentage of adolescents whom we identified as ADHD via the multiple informant assessment but who did not endorse many of the Brown items. These results clearly support previous research that has indicated that adolescents report less ADHD symptoms as compared with their teachers and parents.

This excellent specificity was confirmed when the four groups (ADHD, RD, ADHD+RD, NC) were compared. Indeed, this study is the first to document the effectiveness of the Brown ADD Scale in differentiating between individuals with RD and those with ADHD within an adolescent sample, an important finding suggesting that individuals with RD only do not manifest abnormal or clinical levels of inattention. There were group differences on the subscales of Activation, Attention, and Effort not only between the comorbid group and the RD group but also between the ADHD only group and the RD group. Indeed, the scores of the pure RD group on the Brown were comparable to the control group. The fact that those adolescents we identified as having only RD did not endorse the items of the Brown ADD Scale to a clinically significant degree suggests that the Brown ADD Scale may be tapping into the constructs and deficits specific to a disorder of attention and not reading per se.

Despite poor sensitivity based on the cutoff scores, results indicated that the scale has satisfactory correlations with parent and teacher rating scales, suggesting that there is some agreement among the three informants when scores are compared on a continuum but that when cutoffs (such as with the KSADS or the Brown cutoff scores) are used in conjunction with the collation of information obtained from multiple informants, we eliminate the extent to which these

three informants appear to agree. While it is easy to dismiss the adolescent's report as being an underestimate of the extent to which the symptoms are present, it is also possible that our gold standard of using multiple informants and multiple sources of information results in overidentification of ADHD. It is important to consider that the Brown Scales are attempting to assess beyond the DSM-IV ADHD symptoms and to tap into some of the cognitive problems individuals with ADHD have been documented to experience. As clinicians and researchers, we need to continue to question whether the diagnostic algorithm currently in use is the best method of identifying an individual who is impaired by these symptoms as well as assessing for the cognitive problems underlying these symptoms.

With respect to the various self-report measures, the results suggested that the Brown ADD Scale has better discriminatory features than the self-report scales of the OCHSS and the CRS-R as determined by the inclusion of Brown subscales in a discriminatory function analysis over and above the subscales of the other two self-report scales. The combination of the Attention and Effort subscales with the Family Problems subscale of the CRS-R correctly classified 86.7% of all the participants as either ADHD or nonADHD. The fact that 94.3% of the nonADHD group (which includes all those identified with RD only) was correctly classified indicates that the combination of these three subscales results in excellent sensitivity. However, only 77.8% of the ADHD group was correctly classified, indicating moderate specificity. In other words, although this combination is good at determining whether an individual does <u>not</u> have ADHD, it is less accurate at classifying someone with ADHD as ADHD.

There are a number of limitations that need to be considered in interpreting the results. First, the sample sizes are small and therefore reduce the power to detect group differences that may exist. Further studies could investigate the psychometric properties of the Brown in a larger sample. Nevertheless, given that group differences were found despite the small sample size suggests that

the group differences are meaningful. Second, the RD group was not identified according to the DSM-IV criteria of a Reading Disorder and therefore, the results cannot be extended to this population. However, given that many researchers use the same or a similar method of identification of reading difficulties as used in the current study simplifies interpretations across research studies. Along these same lines, given the way the sample was selected, it is likely to have been a biased sample as some adolescents were clinically referred, others recruited and others volunteered. This can limited the generalizability of the results. Further, given that this sample had an unusually high proportion of females as compared with most studies, it is not entirely representative of typical ADHD youth. On the other hand, there is a dire need across studies to include more females and this study represents a minority that has attempted to increase the gender distribution.

A fourth limitation was the lack of a broadly defined clinical control group, other than just individuals with a reading difficulty. It is possible that such youth would score high on the Brown but not meet full criteria for ADHD via a multi-informant clinical assessment. For example, we saw a few cases where there was a high report of current ADHD symptoms but no past history of ADHD symptomatology. A careful assessment revealed that these "ADHD" symptoms were best explained by another Axis I disorder and not ADHD (e.g., Rucklidge & Tannock, 2000). It was only through interview that the cause of the symptoms could be determined – according to the rating scales, these individuals were scoring within clinical ranges on ADHD symptomatology. Should a clinical comparison group be included in a discriminant function analysis, a higher rate of false positives might be observed, re-emphasizing the need to interpret rating scales in the context of the full clinical assessment. Therefore, although the rate of false positives was low in this sample (and indeed lower than the 5% base rate of ADHD in the general population), we do not know if such a low rate would generalize to other samples. Future studies could investigate how well the Brown

differentiates a clinical sample from an ADHD sample. Finally, although a veritable strength of the study was the inclusion of a pure ADHD, Predominantly Inattentive Type, the downside was the elimination of all those individuals meeting criteria for the other two types of ADHD.

Conclusions

The Brown Adolescent ADD Scale has been in use for over five years but have had no independent studies investigate the scale's validity. This study documents that the scale may assess the less observable ADHD symptoms but cannot on its own, reliably identify an individual who, according to other sources, has ADHD. There is also strong evidence that individuals with RD only are unlikely to score in the clinical range on this scale. The scale also appears to be at least as good as the self-report measures of the CRS-R and the OCHSS and may indeed perform better than these scales in discriminating between samples of adolescents with and without ADHD. It is, however, important to continue to use self-report measures in conjunction with clinical interviews and ratings from multiple informants given the high rate of adolescents who continue to report less symptoms than external observers.

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Table 1

Sample characteristics by Group: Means and Standard Deviations

Variable	Control (NC; n=41)		RD (n=12)		ADHD (n=29)		ADHD+RD (n=16)		F (3, 98)	Contrasts[a]
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Age	15.15	1.17	15.08	1.28	15.17	1.40	15.01	1.54		
Estimated FSIQ	110.24	12.85	99.92	13.98	102.03	8.16	102.35	10.76	4.683*	NC>ADHD, RD
Diagnostic Characteristics:										
(# symptoms): K-SADS-PL										
Inattention	.17	.66	1.67	2.10	6.67	1.99	7.12	.86	172.621**	ADHD, RD, ADHD+RD>NC; ADHD, ADHD+RD>RD
Hyperactivity/Impulsivity	.26	.59	.67	.98	1.93	1.55	2.24	1.92	15.639**	ADHD, ADHD+RD>NC, RD
Oppositional Defiant	.19	.45	.58	1.38	2.50	2.37	2.24	2.02	14.519**	ADHD, ADHD+RD>NC; ADHD>RD
Conduct	.00	.15	.17	.58	.83	1.80	.88	.99	4.549*	ADHD, ADHD+RD>NC
Reading Measures										
WRAT3-Reading	110.88	7.73	90.83	10.02	106.47	7.55	85.76	14.87	36.218**	NC, ADHD>RD, ADHD+RD
WRAT3-Spelling	112.69	8.09	87.92	11.34	103.67	8.05	80.47	10.72	62.585**	NC, ADHD>RD, ADHD+RD
WRMT-R Word Identification	105.90	5.70	87.00	8.31	103.77	7.42	85.00	14.28	35.902**	NC, ADHD>RD, ADHD+RD
WRMT-R Word Attack	104.00	8.37	87.08	8.56	101.9	5.74	86.12	7.94	33.137**	NC, ADHD>RD, ADHD+RD

Note: WRAT3 = Wide Range Achievement Test, WRMT = Woodcock Mastery Reading Tests, *$p < .01$, **$p < .001$, [a]Post-hoc Bonferroni, $p < .05$

Table 2

Brown Raw Scores by Group: Means and Standard Deviations

Variable	Control (NC; n=41)		RD (n=12)		ADHD (n=29)		ADHD+RD (n=16)		F (3, 98)	Contrasts[a]
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Brown ADD Scales										
Activation	6.51	3.87	8.25	4.45	12.28	4.93	14.5	4.35	17.610*	ADHD, ADHD+RD>NC, RD
Attention	5.07	3.82	6.67	4.92	14.52	6.24	16.25	4.52	32.65*	ADHD, ADHD+RD>NC, RD
Effort	4.61	3.29	6.25	1.00	12.38	6.50	16.31	4.56	30.82*	ADHD, ADHD+RD>NC, RD
Affect	3.15	2.47	2.83	2.48	6.14	4.53	6.94	4.95	7.003*	ADHD, ADHD+RD>NC; ADHD+RD>RD
Memory	3.20	2.16	5.75	2.67	8.14	4.21	10.31	3.23	25.67*	ADHD, ADHD+RD>NC; ADHD+RD>RD
Brown Total Score	22.54	12.30	29.75	15.55	53.45	23.47	64.31	17.55	30.98*	ADHD, ADHD+RD>NC, RD

Note: *$p < .001$, [a]Post-hoc Bonferonni, $p < .05$

Table 3

Number and percent of participants across each group classified within each Brown category (unlikely, probable, highly probable)

BROWN CUT-OFF SCORES	Control (n=41)		RD (n=12)		ADHD (n=29)		ADHD+RD (n=16)	
	N	%	n	%	n	%	n	%
Below 40 (ADD possible but not likely)	35	85.4	10	83.33	9	31	3	18.75
Between 40 and 54 (ADD probable but not certain)	6	14.6	1	8.33	6	20.7	3	18.75
55 and above (ADD highly probable)	0	0	1	8.33	14	48.3	10	63.5

	NonADHD (n = 53)		ADHD (n = 45)	
	N	%	n	%
Below 40 (ADD possible but not likely)	45	84.9	12	26.7
Between 40 and 54 (ADD probable but not certain)	7	13.2	9	20.0
55 and above (ADD highly probable)	1	1.9	24	53.3

Table 4

Pearson two-tailed Correlations between the Brown ADD Scales and the OCHSS and CRS-R

	Activation	Attention	Effort	Affect	Memory	Brown Total
Symptoms of ADHD/I (K-SADS)	.633	.767	.751	.468	.666	.747
Symptoms of ADHD/H/I (K-SADS)	.435	.523	.467	.356	.397	.495
ADHD OCHSS – Parent	.398	.535	.525	.350	.425	.509
ADHD OCHSS – Teacher	.572	.637	.635	.402	.504	.628
ADHD OCHSS – Youth	.657	.762	.693	.555	.626	.744
Parent CRS-R						
cognitive problems	.438	.551	.532	.336	.464	.528
Hyperactivity	.335	.422	.373	.274	.342	.396
ADHD Index	.442	.550	.501	.353	.468	.525
Global Index: Restless-impulsive	.400	.493	.471	.363	.437	.488
Global Index: Total	.397	.495	.455	.366	.429	.482
DSM-IV: Inattentive	.447	.555	.521	.370	.469	.535
DSM-IV: Hyperactive-impulsive	.364	.461	.408	.357	.396	.446
DSM-IV: Total	.438	.549	.511	.378	.470	.531
Teacher CRS-R						
cognitive problems	.413	.471	.473	.302	.397	.468
Hyperactivity	.427	.468	.486	.358	.395	.482
ADHD Index	.494	.548	.560	.386	.446	.553
Global Index: Restless-impulsive	.507	.562	.567	.390	.461	.565
Global Index: Total	.480	.535	.550	.389	.422	.540
DSM-IV: Total	.476	.538	.541	.365	.440	.537
Adolescent CRS-R						
Family Problems	.587	.504	.555	.596	.464	.598
Cognitive	.705	.759	.683	.546	.753	.771
Hyperactive	.654	.723	.650	.539	.597	.713
ADHD	.756	.762	.735	.680	.692	.809

Note: All correlations $p < .001$, OCHSS = Ontario Child Health Study Scales, CRS-R = Conners' Rating Scales Revised